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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/618,603

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EXAMINER

DHINGRA, RAKESH KUMAR

ART UNIT

PAPER NUMBER

1763

DATE MAILED: 12/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/618,603

Applicant(s)

MATSUMOTO ET AL.

Examiner

Rakesh K. Dhingra

Art Unit

1763

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on 02 October 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 14, 15, 17, 19, 20, 22, 23, 25, 26 and 41-44 is/are pending in the application.
- 4a) Of the above claim(s) 26, 41 and 42 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 14, 15, 17, 19, 20, 22, 23, 25, 43 and 44 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 14-17, 19, 20, 22-25 and 27 have been considered but are moot in view of the new ground(s) of rejection as explained below:

Applicant has amended claim 14 by adding limitation "wherein at least one antenna is disposed in the process chamber, so as to provide a linear line" and added new claims 43, 44.

New reference by Ye et al (US Patent No. 6,178,920) when combined with Glukhoy, and Totonani et al reads on the limitations of amended claim 14. Accordingly claim 14 has been rejected under 35 USC 103 (a) as explained below.

Further remaining claims 15, 17, 19, 20, 22, 23, 25, 26, 43, 44 have also been rejected under 35 USC 103 (a) as explained below.

Terminal Disclaimer

The terminal disclaimer filed on 10/2/06 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of 10/618602 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly

owned at the time any inventions covered therein were made absent any evidence to the contrary.

Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 14, 15, 23, 25 are rejected under 35 U.S.C. 102(e) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Ye et al (US Patent No. 6,178,920) and Totonani et al (US Patent No. 6,181,069).

Regarding Claim 14: Glukhoy teaches a plasma processing apparatus (Figures 1-3, 6, 7) for supplying microwaves into a process chamber 200 so as to generate plasma P to thereby treat an object W to be processed with the plasma;

wherein the process chamber 200 comprises a top plate 36 and a chamber wall 70 for defining the process chamber; and the chamber wall has at least one antenna 206, 208 so that the antenna penetrates the chamber wall into the inside of the process chamber; and the antenna is disposed in the inside of the process chamber with respect to the top plate (Column 5, lines 15-35 and Column 6, lines 10-30 and Column 8, lines 20-45).

Glukhoy does not teach top plate with plurality of holes for passing a gas to be supplied to the process chamber and also do not explicitly teach antenna penetrate the chamber side wall and provides linear line.

Ye et al teach a plasma apparatus (Figures 5, 6A, 6B) comprising a process chamber 200 with side walls 220 and ceiling (top plate) 240. Ye et al further teach antenna 300 attached to side-wall of chamber and disposed inside the chamber and plurality of gas inlets 270 in the ceiling (top wall) of the chamber (column 8, lines 23-45).

Therefore it would have been obvious to provide plurality of gas inlet ports in the top cover of the chamber as taught by Ye et al in the apparatus of Glukhoy et al to enable selectively supply plurality of precursor gases in areas of different antenna power in the chamber and obtain improved control of plasma species densities and also enables use a wide range of precursor gases that could be used to form plasma (column 8, lines 32-68).

Glukhoy in view of Ye et al teaches all limitations of the claim including antenna 300 disposed within the chamber but do not explicitly teach antenna penetrate the chamber side wall and provides linear line.

Tonotani et al teach a plasma apparatus (Figure 22) comprising a chamber 61 and where internal linear antennas 62 (linear lines) penetrate chamber wall (column 15, lines 15-35).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use linear antennas that penetrate chamber side wall as taught by Tonotani et al in the apparatus of Glukhoy in view of Ye et al to have a simple antenna structure and and also to have an exterior connecting portion (that is outside the chamber).

Regarding Claim 15: Glukhoy teaches that the antenna comprises antenna tubes 208a...208n (voltage-drawing rod) for drawing a voltage from a waveguide or resonator 230 disposed outside of the process chamber; and an insulating material 206a...206n surrounding the voltage-drawing rod (Column 8, lines 25-45). Further, Tonotani et al also teach antennas 62 are covered by dielectric pipes 63 (Figure 22).

Regarding Claim 23: Tonotani et al teach that the plasma apparatus (Figure 14) comprises a probe 54 (measuring device) disposed above quartz window 44 (top plate) to measure the luminous intensity of plasma (Column 13, lines 5-10).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a measuring device as taught by Tonotani et al in the apparatus of Glukhoy in view of Ye et al to monitor the state of plasma.

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Regarding Claim 25: Ye et al teach that apparatus comprises a pedestal (susceptor) 15 for supporting the wafer (object) 20 to be processed is disposed in the process chamber 10, and a bias can be applied (Figure 5 and column 9, lines 1-5)..

Claim 17 is rejected under 35 U.S.C. 102(e) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Ye et al (US Patent No. 6,178,920) and Tonotani et al (US Patent No. 6,181,069) as applied to Claim 15 and further in view of Wartski et al (US Patent No. 5,637,150).

Regarding Claim 17: Glukhoy in view of Ye et al and Tonotani et al teaches all limitations of the claim except length of voltage drawing rod (antenna).

Formula given in the claim: $\{(1=2m)/2\} \lambda_{\text{sub.g}} \pm (1/4) \lambda_{\text{sub.g}}$ when solved for integer value of m as 1, gives length of antenna as $5/4 \lambda_{\text{sub.g}}$ and $7/4 \lambda_{\text{sub.g}}$ which are odd multiples of a quarter of the guide wavelength. For other values of integer also, the antenna length would result in odd multiples of a quarter of wavelength.

Wartski et al teach a microwave plasma apparatus (Figure 1) that includes a plurality of metal antennas 5 disposed inside chamber 4 and where the length of antenna is $k \cdot \lambda / 4$ where k is an odd multiple and λ is the wavelength (Column 2, lines 40-65 and Claim 2).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use antenna length as taught by Wartski et al in the apparatus of Glukhoy in view of Ye et al and Tonotani to obtain optimum coupling of microwave energy with the plasma chamber.

Claims 19, 20, 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Ye et al (US Patent No. 6,178,920) and Tonotani et al (US Patent No. 6,181,069) as applied to Claim 15 and further in view of Minaee et al (US Patent No. 6,558,635).

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Regarding Claims 19, 20, 22: Glukhoy in view of Ye et al and Tonotani et al teach all limitations of the claims except tuner and moving of the voltage drawing rod to enable variable coupling between plasma and waveguide.

Minaee et al teach an apparatus (Figure 3) that has means for moving antenna 19 (voltage drawing rod) to enable match impedance between waveguide 26 and plasma chamber 11 (Column 4, lines 55-62 and Column 5, lines 35-42). Minaee et al further teach that the apparatus has tuning rods 35 and plate 28 for adjusting and tuning

the waveguide 26 to enable antenna 19 deliver the energy to plasma chamber 11.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use tuning and moving means of antenna as taught by Minaee et al in the apparatus of Glukhoy in view of Ye et al and Tonotani et al to match the impedance of the waveguide with the plasma.

Claims 43, 44 are rejected under 35 U.S.C. 102(e) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Ye et al (US Patent No. 6,178,920) and Tonotani et al (US Patent No. 6,181,069) as applied to Claim 15 and further in view of Noguchi (US Patent No. 6,607,633).

Regarding Claims 43,44: Glukhoy in view of Ye et al and Tonotani et al teaches all limitations of the claim but do not explicitly teach interval between antennas (voltage drawing rods). However it is known in the art to locate antennas at an interval of $\frac{1}{2}$ wavelength to obtain advantage of highest amplitude spots.

For example – Noguchi teaches that slot antennas are located at $\frac{1}{2}$ *wavelength interval where the amplitude of microwave is large (column 1, line 65 to column 2, line 15).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to keep interval between antennas to be $\frac{1}{2}$ * wavelength as taught by Noguchi in the apparatus

of Glukhoy in view of Ye et al and Tonotani et al to maximize coupling of microwave energy within the plasma chamber and obtain high density plasma with maximum plasma efficiency.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Rakesh Dhingra



Parviz Hassanzadeh
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Art Unit 1763